GPM

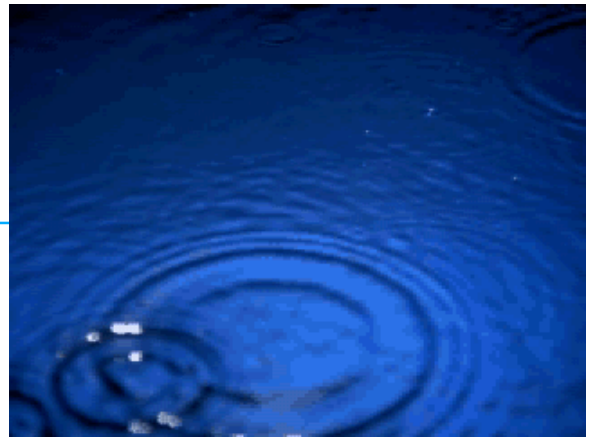
GLOBAL PRECIPITATION MEASUREMENT

Global Precipitation Measurement (GPM)

NASA GPM Ground Validation

Radar Requirements Workshop

November 13-14, 2007



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Workshop Goals

- **Primary Objective: refine/define requirements for a mobile Ka–band/Ku–band radar that can be used for GPM ground validation**
  - Verify the science requirements
  - Review the system requirements and modify them as necessary
  - Get the requirements in shape to exercise one of 3 possible implementation options…
- **Secondary Objective: examine the 3 implementation options**
  - Re-use the UMass AMFR, possibly with some modifications
  - Build out the Remote Sensing Solutions Ka/Ku radar/radiometer antenna feed and transceiver developed under SBIR funding
  - Start a new development “with a blank sheet of paper”
- **Meeting Plan: a few stand-up presentations with lots of time for discussion**

Background

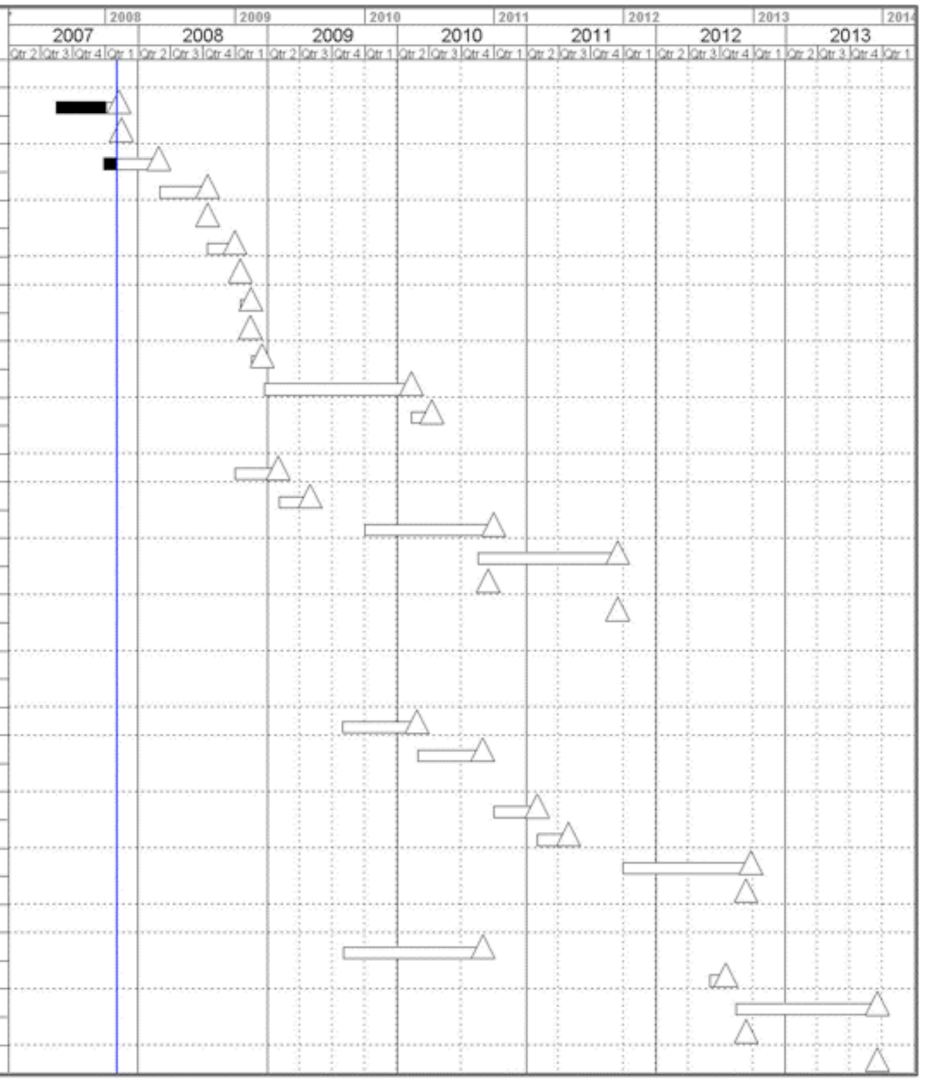
- **The GPM GV *Implementation Plan* calls for a series of field campaigns aimed at**
  - Physical process validation
  - Integrated hydrometeorological validation
- **Field campaigns are organized around specific GPM algorithm needs; success criteria include**
  - Improvement in algorithm retrieval quality
  - Validation of an assumed or parameterized physical process represented within an algorithm
- **Campaigns are being planned on approximately 2-year cycles**
  - C3VP—joint with Met Service of Canada
    - > Ontario, winter 2006-2007: snow and frozen precip retrievals
  - MC3E—joint with DOE
    - > ARM/SGP, spring 2010: passive microwave, DPR & combined rainfall retrieval over land
  - HMT—joint with NOAA
    - > East coast of the US, 2012, precipitation and hydrologic processes

Field Campaign Measurements

- **A wide array of measurements have been proposed for MC3E**
  - Cloud microstructure, microphysics, particle sizes, shape, dist'n, …
  - Precip measurement from radars, profilers, disdrometers, …
  - Surface radiative, sensible & latent heat flux
  - Measurement of large-scale forcing for CRM simulations
  - Supported by ground-based and aircraft measurements
- **Ka/Ku-radar measurements may be a missing piece**
  - Complement to additional scanning radar measurements in S-band and X-band
    - > CASA IP-1 X-band radars likely to be deployed at SGP for the 2010 campaign
    - > S-band measurements potentially available from a number of sources, e.g., S-POL, N-POL, CHILL, local NEXRAD (KVNX, Vance AFB)
  - Perceived need for measurements in the same frequencies as the GPM DPR
  - Perceived need for 13/35 GHz radar measurements of cloud formation and light precip
  - NOAA ESRL, S-POL and (planned) DOE radars operate at Ka frequencies only
  - UMass AMFR operates at Ka & Ku (and W) frequencies, but is currently unfunded for maintenance and sustaining engineering

Field Campaign Schedule

UID	Task	Dur	Start	Finish
1119	**GVS Ground Radar Acq (Ka/Ku Band)**	**730d**	**5/15/07**	**4/9/10**
6979	GVS Radar Gap Analysis	125d	5/15/07	11/8/07
10854	GVS Radar - Planning Workshop	0d	11/15/07	11/15/07
1396	GVS Ground Radar Spec & SOW Dev	104d	9/27/07	2/28/08
1397	GVS Ground Radar RFP Prep	95d	3/3/08	7/15/08
1128	GVS Ground Radar RFP Rel	0d	7/15/08	7/15/08
1399	GVS Ground Radar Industry Proposal Prep - Initial	55d	7/15/08	9/30/08
10626	GVS Ground Radar Industry Proposal Prep - Final	10d	10/1/08	10/15/08
1129	GVS Ground Radar RFP Eval	21d	10/16/08	11/14/08
1400	GVS Ground Radar Contr Award	0d	11/14/08	11/14/08
1398	GVS Ground Radar Negot	21d	11/17/08	12/16/08
1130	GVS Ground Radar Mfg Thru Delivery	285d	12/22/08	2/10/10
1131	GVS Ground Radar Install, Test, & Trng	41d	2/11/10	4/9/10
1146	**GVS IOP-1 Investigator Selection, Ops & Analysi**	**742d**	**10/1/08**	**9/15/11**
1147	GVS IOP-1 PI Selection	82d	10/1/08	1/30/09
1148	GVS IOP-1 PI Grant Awards	63d	2/2/09	4/30/09
1149	GVS IOP-1 PI Site Operations	251d	10/1/09	9/30/10
1150	GVS IOP-1 PI Data Analysis	273d	8/16/10	9/15/11
1151	GVS IOP-1 PI Interim Report	0d	9/15/10	9/15/10
1156	GVS IOP-1 PI Final Report	0d	9/15/11	9/15/11
1161	**GVS IOP-2 Development & Ops**	**1037d**	**7/31/09**	**9/17/13**
1437	**GVS IOP-2 Documentation**	**272d**	**7/31/09**	**8/30/10**
1162	**GVS IOP-2 Implementation Plan**	**272d**	**7/31/09**	**8/30/10**
1163	GVS IOP-2 Impl Plan - Draft	143d	7/31/09	2/26/10
1164	GVS IOP-2 Impl Plan - Final	129d	3/1/10	8/30/10
8249	**GVS IOP-2 Investigator Selection, Ops & Analysi**	**741d**	**10/1/10**	**9/13/13**
8250	GVS IOP-2 PI Selection	81d	10/1/10	1/31/11
8251	GVS IOP-2 PI Grant Awards	63d	2/1/11	4/29/11
8252	GVS IOP-2 PI Site Operations	249d	9/29/11	9/25/12
8254	GVS IOP-2 PI Interim Report	0d	9/11/12	9/11/12
8256	**GVS Aircraft Validation Campaign-1 (AVC-1)**	**1036d**	**8/3/09**	**9/17/13**
8257	GVS AVC-1 Planning	272d	8/3/09	8/31/10
8258	GVS AVC-1 Flight Campaign	31d	6/1/12	7/16/12
8259	GVS AVC-1 Data Analysis & Reporting	275d	8/14/12	9/17/13
8260	GVS AVC-1 Interim Report	0d	9/11/12	9/11/12
8261	GVS AVC-1 Final Report	0d	9/17/13	9/17/13



GPM GV schedule for field campaigns through 2012 (including planning for the 2014 campaign). Schedule for radar procurement also included.

Higher-level Trades

- **GPM GV is confronted with the usual problem: a finite amount of time and money**
  - Assuming a "from scatch" Ka/Ku radar procurement it is probably not possible to *also* field a S-band research radar & disdrometer network for the 2010 campaign
- **Trade studies are planned for the April/May 2008 time-frame**
  1. Decision point on whether to re-use AMFR, build out the Carswell/RSS design, or start from scratch
  2. Decision point on what instruments/measurements to deliver for the 2010 field campaign
     - > Walt Petersen has been polling the GPM community on "critical measurements" for MC3E
     - > Results will factor into the trade study; final decision will be up to GPM Project Scientist

Requirements Issues

- **Additional requirements needed?**
  - Specify minimum detectable signal (e.g., 0 dBz at 10 km)
  - Specify maximum sidelobe
  - Specify a PRF range (see 2.1.45, min range resolution currently ≤50 m)
  - Requirement for continuous operations for X days
  - Requirement for ability to work from commercial power source (e.g., 120V, 240V) and/or auxiliary generator
  - Requirement on up-time (e.g., 99% or some other metric)
  - Requirement for COTS data processing system (e.g., Sigmet/Vaisala)

- **Modify existing requirements?**
  - Max range of ≥40 km (2.1.20)

ACRONYM	DEFINITION
AFB	Air Force Base
ARM	Atmospheric Radiation Measurement
AMFR	Advanced Multi-Frequency Radar
C3VP	Canadian CloudSat/CALIPSO Validation Programme
CASA	Collaborative Adaptive Sensing of the Atmosphere
CHILL	CHicago ILLinois (a research radar at Colorado State University)
CRM	Cloud Resolving Model
DOE	Department of Energy
DPR	Dual-frequency Precipitation Radar
ESRL	Earth System Research Laboratory
GHz	GigaHertz
GPM	Global Precipitation Measurement
GV	Ground Validation
HMT	Hydro-Meteorological Testbed
MC3E	Mid-latitude Contiental Convective Cloud Experiment
NASA	National Aeronautics and Space Administration
NEXRAD	NOAA's NEXt generation RADar
NOAA	National Oceanic and Atmospheric Adminstration
N-POL	NASA Polarimetric Radar
SBIR	Small Business Innovative Research
SGP	Southern Great Plains
S-POL	S-band Polarimetric Radar
UMass	University of Massachusetts